

Title of the Invention

Method and Apparatus for Transporting a Sheet from a Dryer to a Reel

Background of the Invention

5 In the manufacture of paper or tissue products such as facial tissues, bath tissues and paper towels, the base sheets are generally produced by depositing an aqueous suspension of paper making fibers onto a forming fabric, dewatering the suspension to form a web, drying the web and winding the dried web into a roll for subsequent conversion into a particular product. During manufacturing, most webs are adhered
10 to a steam heated Yankee dryer and thereafter dislodged from the surface of the Yankee dryer by contact with a doctor blade (creping) prior to winding to improve the softness and stretch of the sheet.

In some existing processes, the final sheet traverses an "open draw" before being wound into rolls. Accordingly, the dried sheet is
15 momentarily unsupported before being wound. In the case of creped tissue sheets, the sheet is dislodged from the creping cylinder and passed unsupported from the creping cylinder to a reel. This is true for both creped conventional (wet pressed) or creped through air dried (TAD) sheets. In addition, it is envisioned that this process could be
20 utilized on a sheet that is not creped, similar to machine glazed (MG) grades. As known in the tissue manufacturing business, these unsupported runs or open draws are a source of sheet breaks and production delay time. To compensate, the tissue paper sheets are

designed to have high strengths, particularly in the machine direction, in order to remain intact during manufacturing. However, high tissue strengths may negatively impact tissue softness, which is not desirable to the consumer.

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Summary of the Invention

The present invention provides a method and apparatus for transporting a sheet from a Yankee dryer, for example, to a reel, which advantageously leverages the open draw between the dryer and the reel. In so doing, tissue sheets having lower machine direction strength can be made such that the tissue sheets are softer and more substantially square shaped in terms of the machine direction and cross machine direction tensile strengths.

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According to an aspect of the invention, a system for transferring a continuously advancing paper web from a dryer to a reel section is disclosed. The system has a first felt or fabric, which defines a first moving conveyor (herein, first fabric) and a second felt or fabric defining a second moving conveyor (herein, second fabric). The first fabric is positioned downstream from the dryer and may overlap the second fabric for a predetermined distance to receive the paper web between the fabrics. Ideally, the fabrics are permeable fabrics, which may have the same – but more typically – disparate levels of permeability. Permeable fabrics contemplated by the invention generally exhibit air flow in the

range of 50-700 cubic feet per minute (cfm) at 125 pascals pressure drop when the fabrics are new.

The system for transferring the web may also include a vacuum device rotatably disposed against the first fabric. The vacuum device and the dryer may be arranged to form an open draw relative to each other. Optimally, the vacuum device is configured to produce a suction to attract the web to the first fabric for transferring the advancing web into the predetermined distance where the first and second fabric overlap. Further, a reel may be rotatably disposed against the second fabric. If desired, the reel and the second fabric can cooperate to advance the web to a reel spool for winding.

Optimally, a vacuum box may be provided for holding the web against the second fabric. If provided, the vacuum box is disposed adjacent the second fabric. Alternatively, a blow box for holding the web can be substituted for or supplement the vacuum box. Likewise, a static induction device can be used for holding the web in place on the fabrics.

According to another aspect of the invention, a system for transferring the advancing web from the dryer to the reel section can comprise a first felt conveyor or pick-up fabric conveyor configured to receive the web from the dryer at a pick-up point on the first felt. A delivery or second felt conveyor ideally overlaps the first felt conveyor at an overlap area disposed apart from the pick-up point. The first and

second felt conveyors receive the web between the conveyors in the overlap area.

In this aspect, a lead-in roll is rotatably disposed against the first felt conveyor at a predetermined distance from the dryer such that a draw similar to that described above is formed between the dryer and the lead-in roll. The lead-in roll cooperates with the first felt conveyor to transfer the advancing web from the dryer in a direction toward the overlap area. Also, a reel is rotatably disposed against the second felt conveyor. The reel and the second felt conveyor cooperate to advance the web to a reel spool for winding the web.

The system may include a lead-in vacuum box located near the lead-in roll. In this case, the lead-in roll is disposed substantially between the dryer and the lead-in vacuum box, and the lead-in vacuum box suctions the web to the first felt conveyor as the first felt conveyor passes over the lead-in roll. If desired, an air scoop may be disposed substantially between the dryer and the lead-in roll to deflect an air mass from the dryer in a direction substantially toward the first felt conveyor. Additionally, a second vacuum box can be provided adjacent the second felt conveyor in the vicinity of the reel in a direction away from the lead-in roll.

According to another aspect of the invention, a method is disclosed for transporting the web from the dryer to the reel section. The

method may include the steps of continuously advancing the web from the dryer to a first fabric belt. The first fabric belt may be arranged to run across a device located near the dryer for picking up the web. The method may include the substeps of receiving the web on the first fabric belt by the pick-up device, advancing the web on the first fabric belt in the direction of a reel drum, guiding the web between the first fabric belt and a second fabric belt, threading a continuously advancing leading end portion of the web from the second fabric belt onto a reel spool adjacent the reel drum and continuously winding the threaded web into a parent roll from the reel spool. If desired the method may also include the steps of guiding the first fabric belt and the second fabric belt around at least one shear-inducing element while the web is positioned between the belts. Ideally, the first and second belts should be sufficiently wrapped around the at least one shear-inducing element to create shear forces to act upon the web and increase the softness of the web.

Brief Description of the Drawings

The above and other aspects and advantages of the present invention are apparent from the detailed description below in combination with the drawings in which:

Fig. 1 is a schematic diagram of an aspect of the invention illustrating an open draw between a dryer and a lead-in roll;

Fig. 2 is a schematic diagram of an alternative aspect of the invention;

Fig. 3 is a front view of an optional grooved lead-in roll taken along line III-III in Fig. 2; and

5 Fig. 4 is a schematic diagram of another alternative aspect of the invention.

Repeat use of reference characters in the present specification and drawings is intended to represent the same or analogous features or elements of the present invention.

10 Detailed Description of The Drawings

Detailed reference will now be made to the drawings in which examples embodying the present invention are shown. The drawings and detailed description provide a full and detailed written description of the invention, and of the manner and process of making and using it, so as to enable one skilled in the pertinent art to make and use it, as well as the best mode of carrying out the invention. However, the examples set forth in the drawings and detailed description are provided by way of explanation of the invention and are not meant as limitations of the invention. The present invention thus includes any modifications and variations of the following examples as come within the scope of the appended claims and their equivalents.

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As broadly embodied in the Figures, a system for transferring a continuously advancing paper web from a dryer to a reel section is provided. In general, a transfer system 10 is shown with a dryer, for example, a Yankee dryer 12, a creping station or doctor 14, a first fabric 20 (alternatively a first felt conveyor, first fabric belt or pick-up fabric conveyor), a second fabric 30 (alternatively second felt conveyor, delivery conveyor, second fabric felt) and a reel 36 or drum 36.

While Figures 1 and 2 illustrate system 10 having a plurality of conveyor rolls 28, vacuum boxes 34a, 34b and at least two belts 20, 30, it should be understood that the following descriptions of the example embodiments are not intended to limit the present invention to use only in such pre-assembled arrangements nor are all of the foregoing elements required and other elements may be added as required. Accordingly, the present invention is suitable for use with various types of systems for transferring a paper web from a web drying system (e.g., through-air dried, flat or Yankee dryer) to various types of reel sections.

Further, it is to be noted that first fabric 20 and second fabric 30 may be permeable fabrics having the same permeability; more likely, however, first fabric 20 and second fabric 30 have different permeabilities. Also, the permeabilities of the fabrics 20, 30 may change during operation of system 10 due to repeated web W contact with

fabrics 20, 30, which deposits and imbeds dust and debris on the fabrics 20,30.

With more particular reference to the Figures, the Yankee dryer 12 is shown in Fig. 1 delivering the web 18 to the creping station 14 and across a draw D to a vacuum roll 24. In an optimal arrangement, the first fabric belt 20 is located adjacent the second fabric belt 30 such that the first fabric belt 20 picks up the web 18 at a pick-up point 22 and delivers the web 18 in the direction of the second fabric belt 30. The web 18 continues in a direction of the reel 36 first through an overlap area 32 disposed between first fabric 20 and second fabric 30, both of which may be a screen, a fabric or the like. The web 18 continues in the direction of the optional vacuum box(es) 34a, 34b and across reel 36 until it is wound onto a reel spool 37. Reel spool 37 may be a spool, a spool with a core, or a coreless system around which a web 18 winds. It is also contemplated that reel spool 37 may be arranged elsewhere on system 10, such as in a position of reel spool 37', as required.

Fig. 1 further shows an aspect of the invention in which first fabric 20 defines a first moving conveyor. The first fabric 20 is positioned downstream from the dryer 12 and is configured to pick-up and move the web 18 towards the second fabric 30 as the web 18 leaves the creping station 14. The optional creping station or doctor 14 separates and deflects the web 18 from the dryer 12 to the first fabric 20. For instance,

Fig. 1 and 2 illustrate that a transfer plenum 16 may doctor off the web 18 from a surface of the dryer 12 by the transfer plenum 16 riding close to a dryer surface 12a. The doctor 14/transfer plenum 16 are optimally designed to divert and control boundary layer air to promote a smooth tissue or web 18 transition to the first fabric 20.

The second fabric 30 defines a second moving conveyor. The second moving conveyor 30 is overlapped by the first moving conveyor 20 as shown in Fig. 1 for a predetermined distance 32. The overlap area 32 ideally extends partially along both conveyors 20, 30 as shown in Figs. 1 and 2 but theoretically could run from substantially near the pick-up point 22 to the reel 36. Optimally, distance 32 need only be of sufficient length to ensure web 18 is securely positioned on second moving conveyor 30. Accordingly, the first and second moving conveyors 20, 30 in Fig. 1 receive the paper web 18 between the conveyors 20, 30 which extend together toward reel 36 to hold the web 18 in place for transfer to reel 36.

In the foregoing example, vacuum device 24 may again be rotatably disposed against the first moving conveyor 20. The dryer 12 and the vacuum device 24 are then disposed relative to each other to form open draw D. The vacuum device 24 is configured to produce a suction force or vacuum, indicated by arrow 24', to attract the web 18 to the first fabric 20 for transferring the advancing web 18 into the

predetermined distance 32 where the first and second conveyors 20, 30 overlap. If desired, a roll 28a and vacuum device 24 may be arranged to form a nip N into which the web 18 is received after the draw D.

The draw D of system 10 may have a length of between 4 inches to about 48 inches. Optimally, the open draw D defines a distance of between 10 inches to about 30 inches. The inventors have found that a draw D of approximately one foot advantageously accommodates various elements of system 10 while optimizing web 18 transfer from the creping station 14 to the first fabric 20 with fewer web 18 breaks.

As shown in Figure 1, once the web 18 reaches the vicinity of reel 36, web 18 can be held against the second moving conveyor 30 by vacuum boxes 34a, 34b, which operate to maintain a suction, indicated by arrow 34', on the lightweight web 18 to hold it securely against the conveyor 30 until it is wound onto the reel spool. By way of example, vacuum boxes 34a, 34b may be configured to operate at a modest vacuum level of between 0.1" H₂O to about 3.0" H₂O. Alternatively, or also, a blow box 134 or a static induction device 234 (discussed in Fig. 2 below) may be provided in lieu of or in addition to vacuum box 34 to reduce or prevent fly-up of outside edges of web 18, since web 18 may be a tissue product having a basis weight of about 2 grams per square meter (gsm) to about 65 gsm, or about 25 pounds per ream.

Fig. 2 illustrates another aspect of the invention in which a lead-in roll 124 is rotatably disposed against the first felt conveyor 20 a predetermined distance from the dryer 12 such that draw D is formed between the dryer 12 and the lead-in roll 124. The lead-in roll 124 cooperates with the first felt conveyor 20 to transfer the advancing web 18 from the dryer 12 in a direction toward the overlap area 32. If desired, the lead-in roll 124 may have at least one circumferential groove 25 as shown in Fig. 3 to help control boundary layer air in order to assist in the pick-up of web 18 and to hold web 18 on first felt conveyor 20 until web 18 reaches overlap area 32.

With more specific reference to the foregoing aspect, roll 124 with circumferential grooves 25 (Fig. 3) cooperates with the conveyor 20 to thread web 18 from the dryer 12 across draw D to first conveyor 20. In this aspect, tissue or web 18 can be doctored off dryer 12 and drawn by gravity at known web speeds or blown onto conveyor 20, which supports and carries the web 18 to the overlap area 32. Optionally, an air plenum 33 (Fig. 1) may be provided to blow air A in the direction of the felt conveyors 20 and 30 to help to ensure the transfer of web 18 across the draw D to conveyor 20 and towards conveyor 30.

If desired, a lead-in vacuum box 26 may be disposed adjacent the lead-in roll 124 as seen in Fig. 2. In this example, the lead-in roll 124 is thus disposed substantially between the dryer 12 and the lead-in vacuum

box 26. The lead-in vacuum box 26 may be configured to attract the web 18 by suction force to the first felt conveyor 20 as the first felt conveyor 20 passes over the lead-in roll 124. As suggested, box 26 may also be a static induction device or any combination of web attraction devices to attract web 18 to lead-in roll 124 toward overlap area 32.

The exemplary embodiment of Fig. 2 can include one or more web attraction devices, such as vacuum box 34, blow box 134, or static induction device 234, as alluded to in the foregoing embodiment. By way of specific example, the vacuum box 34 is configured to help to maintain the lightweight web 18 against second conveyor 30 until web 18 reaches the reel spool 37 for wind-up.

If desired, vacuum box 34 may include blow box edges (not shown) or be otherwise configured to blow air substantially perpendicular to a direction of movement of the conveyor 30 to create venturi effects (to cause a drop in pressure) in the vicinity of conveyor 30 and assist in holding web 18 against the conveyor 30. Alternatively, web 18 may be held in place by a static induction device 234 in lieu of or in addition to vacuum box 34. The vacuum box 34 may also have replaceable plastic wear edges (not shown) to reduce wear on the fabric 20. With this option, plastic (or other suitable material) wear edges can be easily replaced instead of necessitating replacement of conveyor belts 20 due to frequent, rapid contact with edges of the boxes 34.

It should be understood that the number and placement of boxes 34, 134, 234 are not limited to the examples delineated above nor as shown in the Figures. For instance, the web attraction devices can be placed at any point along the pick-up conveyor 20 and/or delivery conveyor 30.

System 10 may further includes an air scoop 38 disposed substantially between the dryer 12 and the lead-in roll 124. The air scoop 38 is configured to deflect an air mass (not shown) from a rotation of the dryer 12 in a direction substantially toward the first felt conveyor 20 to further assist in controlled transfer of web 18 to conveyor 20.

In another aspect of the invention, at least one shear-inducing element 128 may be disposed as seen for example in Fig 2. In this illustration, at least one of the first and second felt conveyors 20, 30 is sufficiently wrapped around the at least one shear-inducing element 128 to create shear forces that act upon the web 18 and increase the softness of the web 18. This S-wrap configuration may be located at any desired point along conveyors 20, 30 and may include a plurality of such configurations if required.

Fig. 2 also illustrates another aspect of system 10, which may include at least one device, such as exemplary devices 40 a, b, to apply topical agents to the conveyors 20, 30 to coat the web 18. Although two devices 40 a, b are shown, a plurality of such devices may be disposed

at various other locations in system 20. Further, additional devices as well as devices 40 a, b may be configured to each apply distinct topical agents as desired.

Fig. 4 illustrates a further aspect of the present invention in which a system 110 for transferring and reeling a continuously advancing tissue web 18 from dryer 12 to a reel drum 36a until it is wound onto a reel spool 37a. A second reel drum 36b may be used in combination with reel drum 36a to assist in winding a parent roll 48. The system 110 may have only one conveyor 20, which is positioned downstream from the dryer 12 such that draw D is formed between the conveyor 20 and the dryer 12 in an arrangement similar to the foregoing embodiments. Accordingly, the conveyor 20 is configured to continuously receive the web 18 across the draw D and continuously advance the web 18, in contact with a bottom side 20a of conveyor 20 in the direction of the reel drum 36a located within a conveyor loop formed by conveyor 20.

According to another aspect of the invention, a method is disclosed for transporting the web 18 from the dryer 12 to the reel section 36 comprising the step of continuously advancing the web 18 from the dryer 12 to the first fabric belt 20. The first fabric belt 20 may be permeable and is optimally arranged proximate the dryer 12 for picking up the web 18 as described above. Further steps may include receiving the web 18 on the first fabric belt 20 by the pick-up point 22, advancing

the web 18 on the first fabric belt 20 in the direction of a reel drum 36, guiding the web 18 between the first fabric belt 20 and a permeable second fabric belt 30, threading a continuously advancing leading end portion (not shown) of the web 18 from the second fabric belt 30 onto a reel spool 37 adjacent the reel drum 36, and continuously winding the threaded web 18 into a parent roll (not shown) from the reel spool 37.

The method may also include the steps of guiding the first fabric belt 20 and the second fabric belt 30 around the at least one shear-inducing element 128 while the web 18 is positioned between the belts 20, 30. In this example, the first and second belts 20, 30 should be sufficiently wrapped around the at least one shear-inducing element 128 so as to create shear forces that act upon the web 18 to increase the softness of the web 18 as desired by the consumer.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope and spirit of the invention. For example, specific shapes, quantities, and arrangements of various elements of the illustrated embodiments may be altered to suit particular applications. It is intended that the present invention include such modifications and variations as come within the scope of the appended claims and their equivalents.